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EXAMINER	
KIELIN, ERIK J	

ART UNIT	PAPER NUMBER
2813	18

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/754,926	Applicant(s) AHN ET AL.	
	Examiner Erik Kielin	Art Unit 2813	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *20 November 2002* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *2,3,5,6,8-10,31 and 32* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *2,3,5,6,8-10,31 and 32* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *16* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

This action responds to the IDS (Paper No. 16) and the amendment to the claims (Paper No 17), each filed 20 November 2002.

Claim Rejections - 35 USC § 112

1. Claims **10**, 2, 3, 5, 6, 8, 9, 31, and 32 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

The instant specification does not have support for the limitation in amended claim 10, wherein the terminology of co-evaporation of the aluminum oxide and the silicon monoxide have been changed to the mixing of the evaporated aluminum oxide and the evaporated silicon monoxide to form a mixture. The specification provides for no positive mixing step to form a mixture. The specification merely states that co-evaporation results in the mixture being formed incidentally. Such mixing would happen as a matter of course by the laws of nature -- particular entropy, even in the absence of a positive mixing step. (See instant specification at p. 11, lines 3-17.) For the purposes of patentability, the claims will be interpreted in light of the specification in that the mixture is formed incidentally.

The remaining claims are rejected for depending from claim 10.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims **10**, 2, 3, 5, 6, 8, 31, and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 5,923,056 (**Lee** et al.) in view of the basic text of **Vossen and Kern**, Thin Film Processes II, Academic Press: Boston, 1991, pp. 80-81, 108-109, 113-115, 188, 200 and JP 60-167352 A (**Fujisada**).

Regarding independent claim **10**, **Lee** discloses forming a variety of semiconductor devices including MOS, flash EPROM, capacitors, DRAMs, etcetera (i.e. "an assembly) comprising a doped metal oxide, which may be a silicon-doped aluminum oxide (col. 1, line 66 to col. 2, line 10; col. 3, lines 19-40) comprising:

an exemplary method disclosed at cols. 5-6, "EXAMPLE 1", wherein the silicon-doped aluminum oxide layer **18** is formed on a semiconducting material ("silicon wafer **110**") by sputtering (i.e. evaporating) from a target containing aluminum with 1% silicon (i.e. evaporating silicon and aluminum) in a chamber having argon and oxygen, wherein sputtering/evaporation is generated by glow discharge plasma;

the evaporated silicon and aluminum react with the oxygen in the atmosphere to form evaporated silicon oxide and aluminum oxide, which mix and deposit as silicon-doped aluminum oxide **18** on the silicon semiconductor wafer **110**.; and

forming a conductive material (called the "gate **13**" in **Lee**) over the insulating layer silicon-doped aluminum oxide **18**, the conductive material **13** being separated from the semiconductive material **110** by the silicon-doped aluminum oxide layer **18**. (Figs. 1 and 2).

Lee does not disclose that specifically silicon monoxide and aluminum oxide in the form of sapphire are evaporated from separate sources, but does expressly state that the doped metal oxide films, such as the exemplary silicon-doped aluminum oxide film, may be formed using "a conventional deposition technique such as sputtering ..." (col. 2, lines 15-21).

The basic textbook of **Vossen and Kern** teaches conventional techniques for forming thin films including forming a mixed or alloy film using "two-source sputtering, with one source for one alloy component and the other source for the second component." (See p. 200, section entitled "*Targets.*") **Vossen and Kern** also teaches numerous examples of mixed films formed using separate evaporative sources on p. 108-109, Table II. Sources for aluminum oxide (Al_2O_3) and SiO are also taught to be known on pp. 113-115, Table III as well as the composition of the vapor upon evaporation. Note also that even if SiO_2 is used as the evaporative source, that **SiO is the main component of the vapor -- not SiO_2**. So even if SiO_2 is thermally evaporated, SiO is the vapor species formed.

It would have been obvious to one of ordinary skill at the time of the invention to use a silicon monoxide source and an aluminum oxide source to form a silicon doped aluminum oxide film as a matter of design choice because the choice of SiO and Al_2O_3 sources are well known and will result is the same silicon-doped aluminum oxide as that disclosed in **Lee**, and because **Lee** teaches "a conventional deposition technique such as sputtering" will work, and because the

use of separate sources to form a mixed or alloy layer is conventional, as taught by **Vossen and Kern**.

Applicant could overcome the rejection by providing evidence that the specific use of silicon monoxide and aluminum oxide provides unexpected results in the Si-doped aluminum oxide film relative to that source used in **Lee**. Presently there is no such evidence of record.

Then the only difference is that sapphire is not taught to be the aluminum oxide source.

Fujisada teaches the benefits of preventing injurious impurities from being incorporated into sputter-deposited aluminum oxide films by using a sapphire target, specifically for use in semiconductor device applications. (See Abstract.) Note that sapphire is necessarily single crystal because that which distinguishes aluminum oxide from sapphire is *only* the fact that sapphire is a single crystal of aluminum oxide.

It would have been obvious to one of ordinary skill at the time of the invention to use a sapphire source as the aluminum oxide source in the method of **Lee** in view of **Vossen and Kern** to prevent contamination of the deposited film, as taught by **Fujisada**.

Regarding claim 2, the omission of O_2 is obvious since the oxygen component is already provided in the known SiO and Al_2O_3 sources. One of ordinary skill would be motivated to leave out the oxygen since it is already provided in the sources used.

Regarding claim 3, 5, and 6, **Lee** does not specifically indicate that the evaporation means is thermal evaporation, but **Vossen and Kern** teach the thermal evaporation is one of the art-recognized equivalent means of evaporating a source material to deposit a film. (See Vossen and Kern, p. 80, second sentence under section entitled "Evaporation Process.") **Vossen and**

Kern also teach that evaporation is conventionally carried out using, *inter alia*, electron beams (guns) (pp. 80-81), and that ion beams are conventionally used for sputter deposition (p. 188).

It would have been obvious for one of ordinary skill in the art, at the time of the invention to use thermal evaporation, electron beams (guns), or ion beams as the method of evaporating sapphire, as taught by **Lee** in view of **Vossen and Kern** and **Fujisada**, because **Vossen and Kern** teach that each evaporation means is an art known means in which to evaporate a source to deposit a film. Moreover, there is no evidence of record that thermal evaporation provides some unexpected results relative to the other methods. Rather the evidence of record teaches away from any unexpected result since plural methods are indicated in the specification and claimed as being usable for evaporating the aluminum oxide source, whether it is sapphire or just aluminum oxide.

Regarding claim 8, **Lee** discloses the silicon substrate (col. 5, line 56).

Regarding claim 31, **Lee** specifically states that the dopant is 0.1 to 30 weight percent of the dielectric film. (See Abstract.)

Regarding claim 32, **Lee** teaches an exemplary embodiment where the substrate temperature is 380 °C, but does not indicate that the semiconductor material is at room temperature during the deposition.

Vossen and Kern teach several examples of forming doped metal oxides using and SiO target, for example, wherein the temperature range of the substrate is 25-300 °C. (See Table II.)

It would have been obvious for one of ordinary skill in the art, at the time of the invention to deposit the silicon-doped aluminum oxide of **Lee** at room temperature, because **Lee** teaches conventional sputtering methods may be used and **Vossen and Kern** teaches that sputtering at

room temperature is conventional for doped oxide formation. Furthermore, it would be a matter of routine optimization to sputter deposit the silicon-doped aluminum oxide at room temperature because it is a matter of determining optimum process condition by routine experimentation with a limited number of species. See *In re Jones*, 162 USPQ 224 (CCPA 1955)(the selection of optimum ranges within prior art general conditions is obvious) and *In re Boesch*, 205 USPQ 215 (CCPA 1980)(discovery of optimum value of result effective variable in a known process is obvious). One of ordinary skill would be especially motivated to use room temperature since **Vossen and Kern** teach that this temperature is conventional and in order to reduce the thermal budget which enables the production of smaller device features without fear of diffusion or damaging previously formed device features.

4. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Lee** in view of **Vossen and Kern** and **Fujisada** as applied to claim **10**, above, and further in view of **Wolf**, Silicon Processing for the VLSI Era, Vol. 1 : Process Technology, Lattice Press: Sunset Beach, CA 1986, p. 5.

Lee does not specifically state that the silicon substrate is "monocrystalline."

Wolf teaches that integrated circuits are formed on monocrystalline or "single crystal" silicon substrates (p. 5, first paragraph under section entitled "Manufacture of Single Crystal Silicon.")

It would have been obvious to one of ordinary skill at the time of the invention to use the notoriously well-known monocrystalline substrates as the silicon substrate of **Lee**, because **Wolf**

teaches that monocrystalline is always used over other forms of silicon to enable sufficient carrier lifetime in semiconductor devices.

Response to Arguments

5. Applicant's arguments filed 20 November 2002 (Paper No. 17) have been fully considered but they are not persuasive.

Applicant argues on p. 4, fourth paragraph, of the Amendment (Paper No. 17) that none of the references teaches the positive mixing step. This argument is irrelevant since the instant invention has not enabled a positive mixing step beyond that which occurs incidentally as noted above in the rejection under 35 USC 112(1). Moreover, the prior art of **Vossen and Kern** provide evidence that mixing occurs naturally since examples are provided therein which used separate evaporative sources to produce a film containing both sources.

In the paragraph bridging pages 4 and 5, the argument regarding the amendment to include that the sapphire is a *single crystal* sapphire is merely redundant since the definition of sapphire is that it is a single crystal of aluminum oxide --just as single crystal carbon is diamond. To call a diamond a single crystal is merely redundant.

In the paragraph bridging pp. 5 to 6, Applicant argues that the **Lee** reference alone does not teach the method of deposition. Examiner agrees, and this has already been noted in the rejection which is not over **Lee** alone but is instead over **Lee** in view of **Vossen and Kern** and, now, also **Fujisawa**.

In the paragraph bridging pp. 6-7, Applicant argues that **Vossen and Kern** do not teach specifically SiO and Al_2O_3 sources as a specific two source system. Again, the rejection **Vossen and Kern** alone, but is instead over **Lee** in view of **Vossen and Kern** and, now, also **Fujisawa**.

Applicant further argues in this regard, "Applicant respectfully submits that it is improper for the Examiner to contend that the listed two-source evaporation systems of **Vossen and Kern** can be extended to Applicant's recited system without some teaching of a reason for making such a system, and a reasonable expectation of success." Examiner respectfully asserts that such suggestion is implicitly present in combined teachings of **Lee** and **Vossen and Kern** for the reasons indicated above, and as elaborated upon herein. Note that "[I]n considering the disclosure of a reference, it is proper to take into account not only specific teachings of the reference but also the inferences which one skilled in the art would reasonably be expected to draw therefrom." *In re Preda*, 401 F.2d 825, 826, 159 USPQ 342, 344 (CCPA 1968) See also *In re Lamberti*, 545 F.2d 747, 750, 192 USPQ 278, 280 (CCPA 1976).

With this in mind, **Lee** suggests using a conventional technique to form a film containing Si-doped aluminum oxide, which is a suggestion that the exemplary embodiment in **Lee** is not limiting to the method of deposition of the silicon-doped aluminum oxide film and, furthermore, motivates one of ordinary skill to use any conventional sputtering method -- not just the exemplary one included. The general textbook of **Vossen and Kern** goes to provide proof of what is generally known to one of ordinary skill in terms of forming a mixed composition layer using evaporation (e.g. sputtering) techniques. Since **Vossen and Kern** specifically teaches that it is known to use a at least two targets of different materials to form an mixture thereof, one expressly knows from such teaching that, if a silicon-aluminum oxide is to be formed (from **Lee**)

that this may be formed by *any* targets containing silicon, aluminum, or oxygen, whether separately provided or together in a single target (by the implicit suggest of **Vossen and Kern)**.

Applicant also appears to argue that the specific targets SiO and Al_2O_3 to form a silicon-aluminum oxide must somehow expressly be shown in order to provide the suggestion to use such a combination. For the reasons just indicated, Examiner respectfully disagrees that such suggestion is the *only* such suggestion leading one of ordinary skill to use such targets. Rather, the implicit suggestion provided by **Vossen and Kern** is sufficient to suggest one of ordinary skill specifically what materials must appear in the targets used to form a given layer -- specifically that each of the elements in the layer may be present. And as long as the elements are present, there exists a reasonable expectation that those elements will end up in the deposited film.

To elaborate, the elements of a silicon-doped aluminum oxide film are Al (aluminum), Si (silicon), and O (oxygen). By the text of **Vossen and Kern**, the express suggestions are to use any of the following targets: (1) a single target containing Si, Al, and O (e.g. an aluminosilicate); (2) a first target using Si and a second having Al and O; (2) a first target containing Si and O and a second containing Al; (3) a first target containing Si and O (e.g. SiO or SiO_2) and a second target containing Al and O (e.g. Al_2O_3); or (4) separate Si and Al targets or a combined SiAl target used while reactive sputtering in an O-containing atmosphere.

Accordingly, the combination of SiO and aluminum oxide source is implicitly suggested by the combination of **Lee** with **Vossen and Kern**.

In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on

obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971). For the reasons already indicated including those in the rejection, Examiner respectfully asserts that no hindsight reasoning has been used.

Conclusion

6. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Erik Kielin whose telephone number is 703-306-5980. The examiner can normally be reached on 9:00 - 19:30 on Monday through Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached at 703-308-4940. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9318 for regular communications and 703-872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

Erik Kielin
February 1, 2003